Claims

WE CLAIM:

1. A method of modeling circulation in a living subject, such method comprising the steps of:

    developing a model for living subjects in general;

    correcting the model to substantially conform to the overall cerebral physiology of the living subject; and

    calculating a cerebral flow of the living subject based upon the corrected model and a selected cerebral blood flow perturbation.

2. The method of modeling as in claim 1 wherein the step of developing the model further comprises adopting the Circle of Willis.

3. The method of modeling as in claim 1 wherein the step of correcting the model further comprises selecting a vessel of the model.

4. The method of modeling as in claim 3 wherein the step of selecting a vessel of the model further comprises identifying a general area of a corresponding vessel in an image of the living subject.

5. The method of modeling as in claim 4 wherein the step of identifying the corresponding vessel further comprises localizing the corresponding vessel in 3-dimensional space.

6. The method of modeling as in claim 5 wherein the step of localizing the corresponding vessel further

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comprises measuring a diameter of the corresponding vessel. *using an Attention-Based Model*

7. The method of modeling as in claim 6 wherein the step of processing pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue further comprises tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

8. The method of modeling as in claim 7 further comprising updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

9. The method of modeling as in claim 8 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

10. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.

11. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.

12. Apparatus for modeling cerebral circulation in a living subject, such apparatus comprising:

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a cerebral circulation model for living subjects in general;

means for correcting the model to substantially conform to the overall cerebral physiology of the living subject; and

means for calculating a cerebral flow of the living subject based upon the corrected model and a selected cerebral blood flow perturbation.

13. The apparatus for modeling as in claim 12 wherein the cerebral circulation model further comprises the Circle of Willis.

14. The apparatus for modeling as in claim 12 wherein the means for correcting the model further comprises means for selecting a vessel of the model.

15. The apparatus for modeling as in claim 14 wherein the means for selecting a vessel of the model further comprises means for identifying a general area of a corresponding vessel in an image of the living subject.

16. The apparatus for modeling as in claim 15 wherein the means for identifying the corresponding vessel further comprises means for localizing the corresponding vessel in 3-dimensional space.

17. The apparatus for modeling as in claim 16 wherein the means for localizing the corresponding vessel further comprises means for measuring a diameter of the corresponding vessel.

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18. The apparatus for modeling as in claim 17 wherein the means for processing pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue

5 further comprises means for tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

19. The apparatus for modeling as in claim 18 further

10 comprising means for updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

20. The apparatus for modeling as in claim 19 wherein

15 the means for calculating the cerebral flow further comprises means using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

20 21. The apparatus for modeling as in claim 20 wherein the means for calculating the cerebral flow further comprises means using a Navier-Stokes momentum equation.

22. The apparatus for modeling as in claim 21 wherein

25 the means for calculating the cerebral flow further comprises means using an equation of state relating a local pressure to a local artery size.

23. Apparatus for modeling cerebral circulation in a

30 living subject, such apparatus comprising:
        a cerebral circulation model for living subjects in general;

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a correction processor adapted to correct the model to substantially conform to the overall cerebral ~~physiology~~ of the living subject; and

a flow processor ~~adapted to calculate~~ a cerebral
5 flow of the living subject based upon the corrected model and a selected cerebral perturbation.

24. The apparatus for modeling as in claim 23 wherein the cerebral circulation model further comprises the
10 Circle of Willis.

25. The apparatus for modeling as in claim 23 wherein the correction processor further comprises a cursor adapted to select a vessel of the model.
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26. The apparatus for modeling as in claim 25 wherein the correction processor further comprises a pixel processor adapted to process pixel data of the general area of the corresponding vessel to locate a boundary
20 area between the corresponding vessel and surrounding tissue.

27. The apparatus for modeling as in claim 26 wherein the pixel processor further comprises a distance
25 processor adapted to measure a diameter of the corresponding vessel.

28. The apparatus for modeling as in claim 27 wherein the pixel processor further comprises a ~~tracing~~
30 processor adapted to trace the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

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29. A method of modeling a surgical alteration of
cerebral circulation in a living human subject, such
method comprising the steps of:
       developing a model for living subjects in general;
       correcting the model to substantially conform to
the cerebral physiology of the living subject;
       perturbing the corrected model; and
       determining a set of flow changes occurring as a
10   result of the perturbation.

30. The method of modeling as in claim 29 wherein the
step of developing the model further comprises adopting
the Circle of Willis.
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31. The method of modeling as in claim 29 wherein the
step of correcting the model further comprises selecting
a vessel of the model.

20   32. The method of modeling as in claim 31 wherein the
step of selecting a vessel of the model further
comprises identifying a general area of a corresponding
vessel in an image of the living subject.

25   33. The method of modeling as in claim 32 wherein the
step of identifying the corresponding vessel further
comprises localizing the corresponding vessel in 3-
dimensional space.

30   34. The method of modeling as in claim 33 wherein the
step of localizing the corresponding vessel further

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comprises measuring a diameter of the corresponding vessel.

35. The method of modeling as in claim 34 wherein the step of processing pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue further comprises tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.

36. The method of modeling as in claim 35 further comprising updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.

37. The method of modeling as in claim 36 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.

38. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.

39. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.

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40.   Apparatus for modeling a surgical alteration of
cerebral circulation in a living human subject, such
apparatus comprising:

     a cerebral model for living subjects in general;
5   means for correcting the model to substantially
conform to the cerebral physiology of the living
subject;

     means for perturbing the corrected model; and

     means for determining a set of flow changes
10   occurring as a result of the perturbation.

41.   The apparatus for modeling as in claim 40 wherein
the means for correcting the model further comprises
means for selecting a vessel of the model.

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42.   The apparatus for modeling as in claim 41 wherein
the means for selecting a vessel of the model further
comprises means for identifying a general area of a
corresponding vessel in an image of the living subject.

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43.   The apparatus for modeling as in claim 42 wherein
the means for identifying the corresponding vessel
further comprises means for localizing the corresponding
vessel in 3-dimensional space.

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44.   The apparatus for modeling as in claim 43 wherein
the means for localizing the corresponding vessel
further comprises means for measuring a diameter of the
corresponding vessel.

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45.   The apparatus for modeling as in claim 44 wherein
the means for processing pixel data of the general area

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of the corresponding vessel to locate a boundary area
between the corresponding vessel and surrounding tissue
further comprises means for tracing the boundary into
adjacent areas in three-dimensional space to locate
5   respective ends of the corresponding vessel.

46.   The apparatus for modeling as in claim 45 further
comprising means for updating the model based upon the
measured diameter and locations of the respective ends
10   of corresponding vessel.

47.   The apparatus for modeling as in claim 46 wherein
the means for calculating the cerebral flow further
comprises means using a one-dimensional, explicit,
15   finite difference algorithm based upon a conservation of
mass equation.

48.   The apparatus for modeling as in claim 47 wherein
the means for calculating the cerebral flow further
20   comprises means using a Navier-Stokes momentum equation.

49.   The apparatus for modeling as in claim 48 wherein
the means for calculating the cerebral flow further
comprises means using an equation of state relating a
25   local pressure to a local artery size.

50.   A method of modeling a surgical alteration of
circulation in a predetermined region of a living human
subject, such method comprising the steps of:
30   developing a model of the region for living
subjects in general;

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correcting the model to substantially conform to the physiology of the region of the living subject;

~~perturbing the corrected model; and~~

determining a set of flow changes occurring as a
5   result of the perturbation.

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